

**UNITED STATES DEPARTMENT OF THE INTERIOR
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U. S. Fish and Wildlife Service
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**AN EVALUATION OF FIVE YEARS OF LOGGING RECOMMENDATIONS
FOR AQUATIC HABITAT PROTECTION ON THE QUINULT INDIAN RESERVATION**

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INTRODUCTION

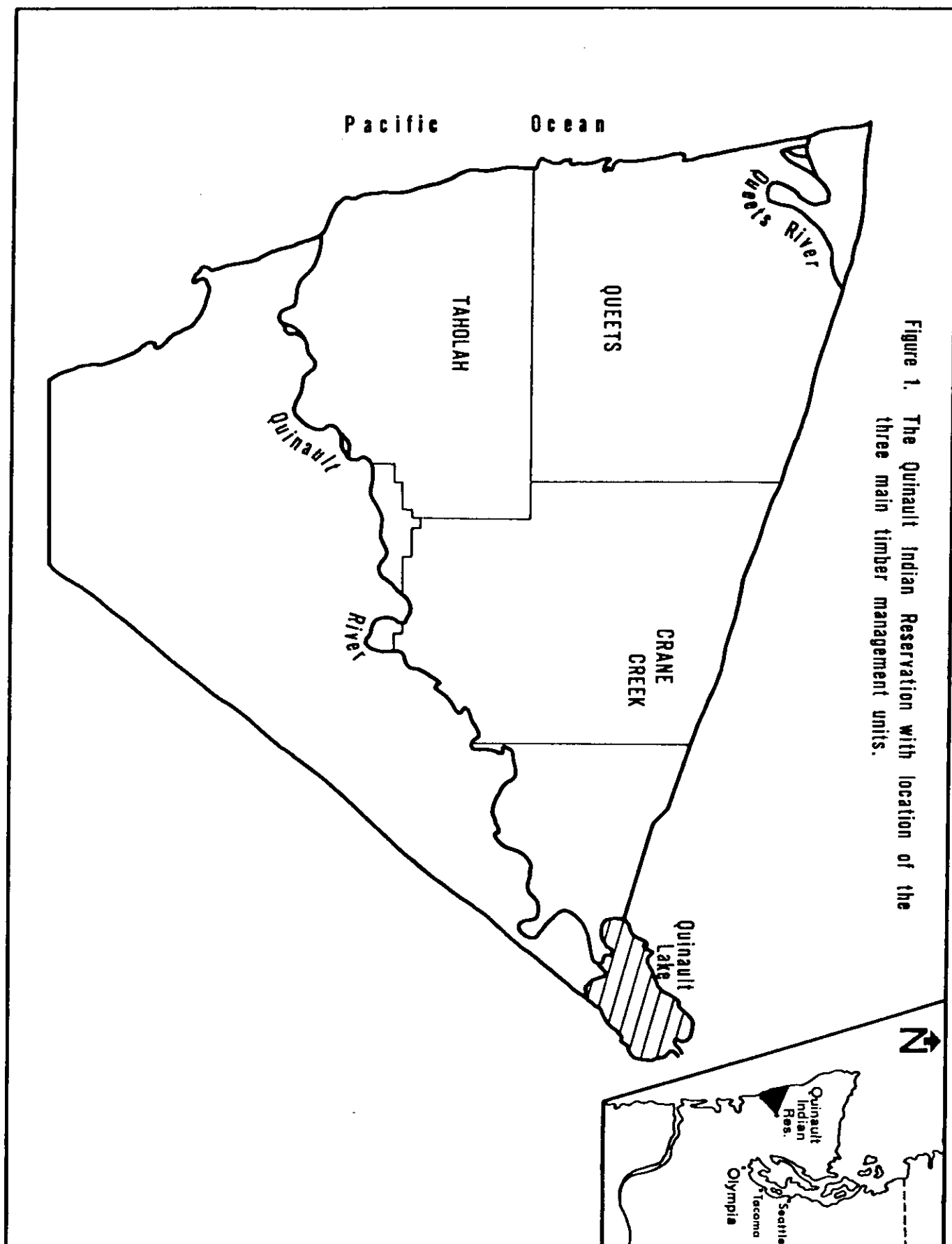
The Fisheries Assistance Office (FAO) of the U.S. Fish and Wildlife Service (USFWS) has been involved in developing recommendations for the protection of the aquatic habitat from the adverse impacts of logging. Our primary area of concern is the Quinault Indian Reservation where we have been active since 1972. Our recommendations are developed by application of "state of the art" knowledge regarding aquatic habitat protection. To date over 200 logging blocks were individually inspected prior to logging and, consequently, recommendations developed to minimize logging-associated impacts to the aquatic habitat. However, there has been little follow-up work to determine the effectiveness of our recommendations. Therefore, during the summer of 1978 we began to make field inspections of logged blocks for which recommendations had been made. This report presents the results of our field data.

Our current involvement on the Quinault Reservation is related to historic events; a brief review of these will aid in reader perspective. The Reservation was established in 1856. During 1873 the current boundaries -- the Pacific Ocean on the west and the Olympic Mountains on the north and southeast -- were designated, creating the triangular-shaped Reservation encompassing about 300 square miles of forested land. Major logging of the forests in this area began in 1922 when large management units, including Crane Creek, Queets and Taholah (Figure 1), were contracted to logging companies by the Bureau of Indian Affairs (BIA). In 1971, years of concern over logging practices, forest management, and related environmental problems resulted in assembly of the Quinault Tribal Council study group.

This group was composed of members from the USFWS, Environmental Protection Agency (EPA), U.S. Forest Service (USFS) and the BIA. It was organized to review the resource problems on the Quinault Reservation and make recommendations for future resource management. The report which developed from their field investigation pointed out that serious resource management problems existed and were a result of timber harvest practices. Heavy slash accumulation, and inadequate culvert installation and poor road design were examples of the numerous problems that were clearly implicated as adverse to balanced management of the natural resources of the Reservation. In a closing statement, the study group recommended that guidelines be adopted which would establish a framework for implementation of environmental protection measures.

In 1972, the BIA requested that the FAO develop logging recommendations specific for the management of the aquatic resources on timber blocks to be logged the following year. This arrangement has continued through the years, with our recommendations aimed at minimizing logging-associated impacts which have been reported in scientific literature to be detrimental to aquatic resources, particularly fish. For example, recommendations such as stream cleaning or suspension yarding reflect the use of

Figure 1. The Quinault Indian Reservation with location of the three main timber management units.

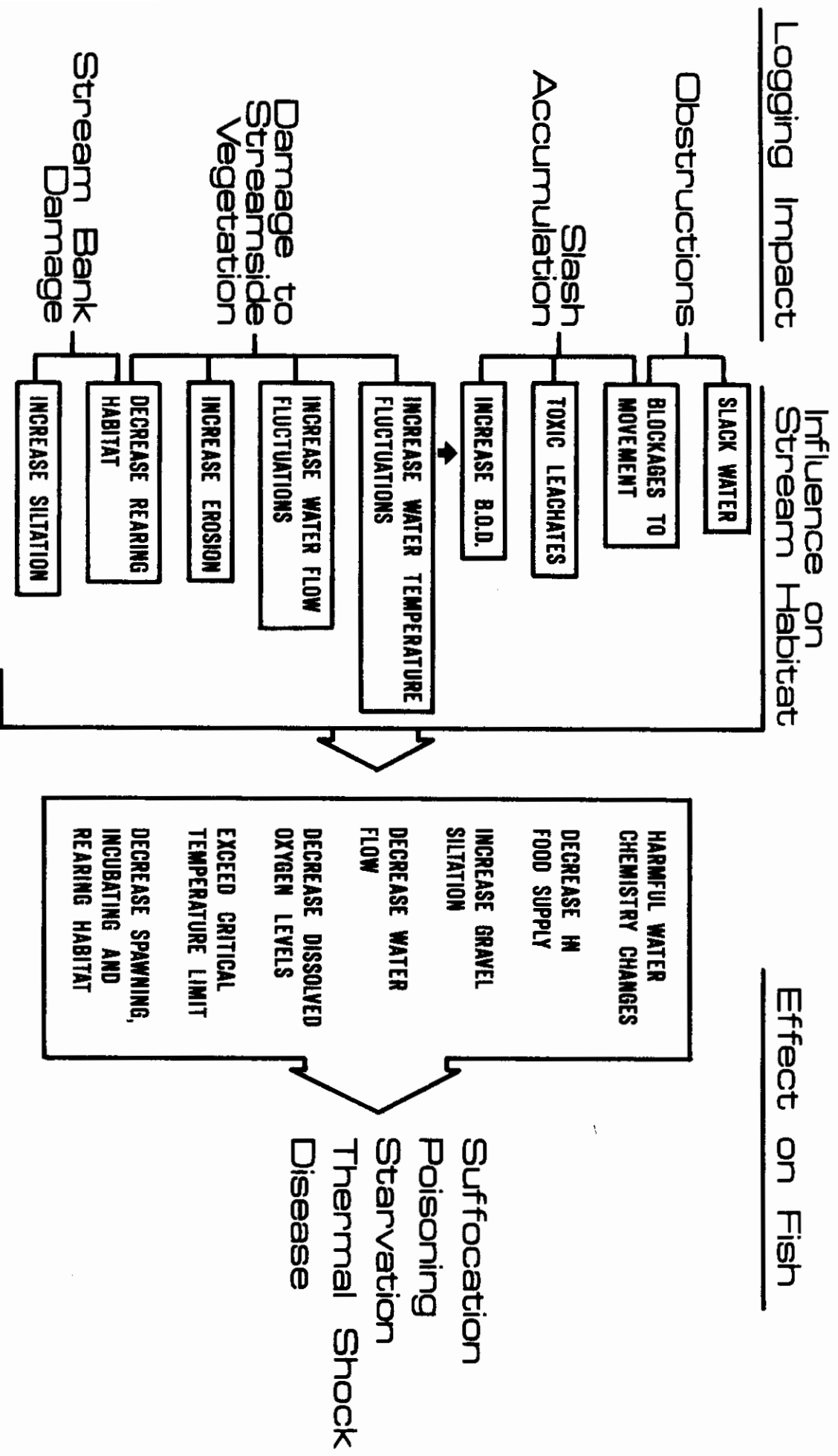


information sources such as Geen (1975), who pointed out that the finite energy reserves of adult salmonids, if used to negotiate blockages to their spawning grounds, can have profound effects on ability and success of spawning. Our recommendations for specific yarding procedures or road construction are an application of research by Iwamoto et al. (1978) who showed that logging-associated impacts such as timber yarding through streams or road construction can generate silt that in turn causes stream turbidity and/or sedimentation. These two impacts can have major effects on fish by limiting spawning behavior, egg viability and/or food availability. In addition, on the Alsea watershed (Oregon), Hall and Lantz (1969) found that the silt content of stream-bed gravel can decrease survival of pre-emergent coho salmon by presenting an impenetrable physical barrier to emergence. Reduction of fish survival due to silt has also been shown by Wickett (1958) to be related to reduction of intergravel water flows which reduce oxygen supplies and removal of toxic metabolic wastes.

Free swimming fry have also been shown to be adversely impacted by logging practices. Slash and debris in streams can create a low dissolved oxygen level due to the increased biological oxygen demand (Hall and Lantz, 1969). Also, toxic leachates from such material, particularly cedar, has been shown to be deleterious to fish eggs and alevins and fry (Peters et al. 1976). Still another contribution to reduction of dissolved oxygen is increased water temperatures. Broun and Krygier (1970) clearly showed the relationship between removal of streamside vegetation and increased water temperatures. In addition, Sartz (1951) indicated that streamside vegetation can moderate water flows by promoting infiltration and water storage, thereby reducing surface runoff and the associated silt load entering streams. To reduce these logging impacts our recommendations have included suspension yarding, buffer strips and reestablishment of riparian vegetation.

Although numerous logging practices have been shown to influence the quality and quantity of our aquatic resources (Gibbons and Salo 1973), we have limited the scope of this study to the evaluation of four logging-associated impacts. These and some of the effects on aquatic habitat are shown in Figure 2. We felt these four impacts could be used in a practical evaluation of the aquatic habitat on the blocks where logging recommendations were developed. Importantly, numerous scientific publications clearly show the relationship between these impacts and subsequent aquatic habitat degradation causing deleterious effects to fish. Evaluation of the magnitude of these adverse logging impacts was considered a viable, albeit indirect, measure of the suitability of the aquatic habitat for fish.

Figure 2. Influence of logging on the aquatic habitat and subsequent deleterious effect on fish.



METHODS

Over 200 logging blocks on the Quinault Reservation have received our logging recommendations since 1972 (Figure 3). All these recommendations were accumulated from our files and grouped by the year and management unit of the Reservation (Crane Creek, Queets, or Taholah). The legal description, BIA reference number and date of each logging block was then checked for accuracy with files maintained by the BIA. Logging dates and necessary boundary maps were obtained. A workable sample of logging blocks, representing the appropriate management areas, was selected for field inspection. Block selection was based on four factors:

1. Representative topography of the management area. (The BIA foresters assigned to the specific area assisted in this selection.)
2. Stream characteristics. (Approximate stream width, gradient and water flows were used to characterize streams.)
3. Year logged.
4. Convenient distribution.

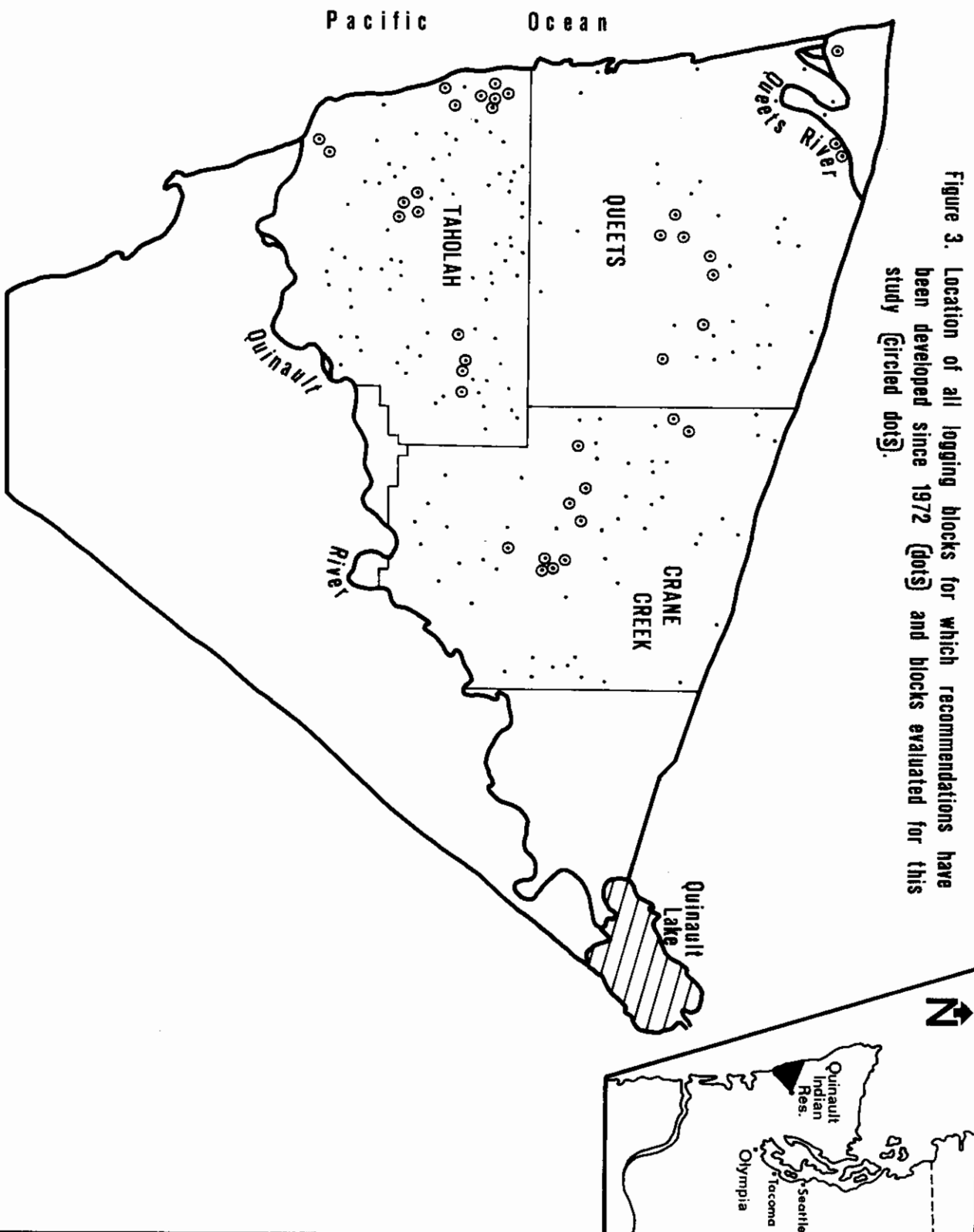
This selection process yielded 39 logging blocks -- 11 from Crane Creek, 17 from Taholah and 10 from the Queets unit (Figure 3). Each of these was visited, and field observations made. An inspection check was developed specifically for each block. This list included:

1. A work sheet itemizing the four selected logging impacts with space for field observations and general conditions.
2. A copy of our logging recommendations specific to the particular block to be inspected.
3. Aerial photographs of the appropriate block.

In cooperation with BIA foresters, and equipped with the field inspection check list, each of the 38 blocks was inspected and the appropriate observations recorded. Finally, color photographs were taken of the general conditions and specific problems as necessary.

Following our field inspection, numerical evaluation for the logging impacts was determined. The value of the logging impacts relative to aquatic habitat protection was determined by evaluating the degree of the impact of: 1) slash and debris accumulation in streams, 2) damage to streamside vegetation, 3) streambank degradation, and 4) obstructions to fish movement.

Figure 3. Location of all logging blocks for which recommendations have been developed since 1972 (dots) and blocks evaluated for this study (circled dots).



Each of these four factors was evaluated as shown in Table 1. The total aquatic habitat protection of each block was then determined by summing the scores for each of the four target impacts. This system assigned highest values (maximum of 4 points) to aquatic habitat which had been least impacted from the four categories above.

The accumulated logging impact was then categorized as follows:

<u>Accumulated Point Value</u>	<u>Aquatic Habitat</u>
4.00 to 3.00	Insignificantly damaged
Less than 3.00 to 2.00	Moderately damaged
Less than 2.00 to 1.00	Significantly damaged

A comparable numerical evaluation was not suitable for the results obtained regarding the adherence to our logging recommendations. Post-logging field observations for adherence to recommendations were either clear-cut or, as a result of normal changes, ambiguous. Therefore, any recommendations for which distinct factual observations were not possible were eliminated from the evaluation process. The remaining data was used for a percentage adherence value.

To determine the effectiveness of the recommendations for aquatic habitat protection, a case-by-case approach was used. Since a single recommendation was often applicable to several of the four logging impacts being evaluated, this technique was necessary to fully investigate strong or weak points of our recommendations. Hence, when each recommendation was applied to as many impacts as was relevant, from one to as many as four cases resulted. Each case compared recommendation adherence or non-adherence to the specific logging impact.

RESULTS

The initial evaluation of the field data was aimed at determining the relationship between our logging recommendations and aquatic habitat protection. Figure 4 shows the results -- when all cases in which all recommendations were followed (89) were compared to those cases where all recommendations were not followed (73), we found a high correlation between adherence to our recommendations and aquatic habitat protection. As shown, in all the management units, when recommendations were completely followed the logging impact was evaluated to be moderate, with from 61% (Taholah) to 100% (Queets) of the associated habitat protected from logging. Yet in the same units, when similar recommendations were all not followed, the logging impact caused from 77% (Crane Creek) to 94% (Queets) damage to the associated aquatic habitat.

Table 1. Value of four logging-associated impacts on the aquatic environment.

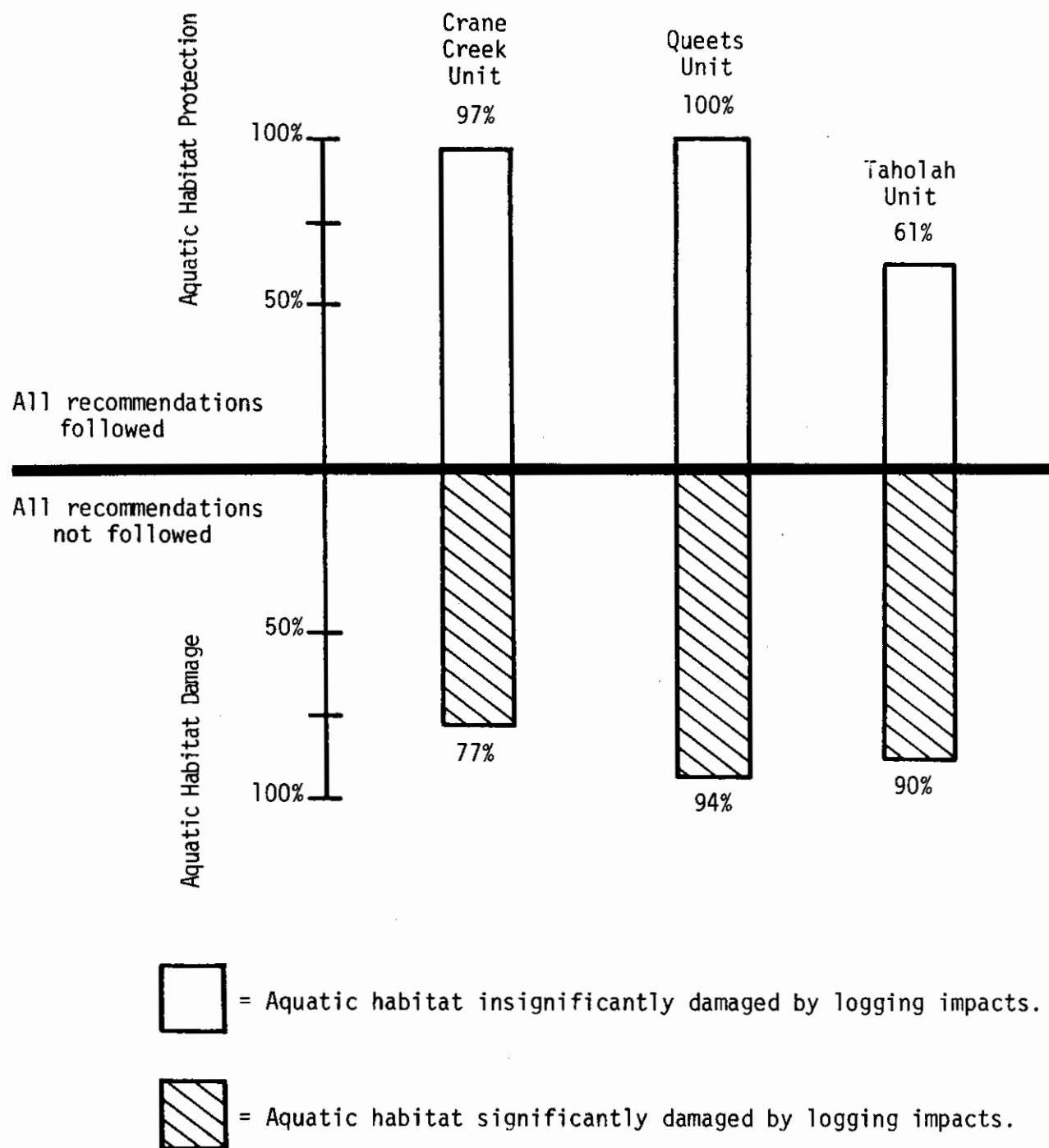
SLASH AND DEBRIS IN STREAMS		
<u>Description</u>	<u>Numerical Value</u>	<u>Effect of Impact</u>
Slash was not present	1.00	Insignificant
Slash was present in not more than 20% of stream and posed no apparent blockage to fish movement	0.75	
Slash was present in from 20% to 50% of the stream and/or believed to inhibit fish movement	0.50	Significant
Slash was covering over 50% of stream and/or completely blocked fish movement. .	0.25	

BANK DEGRADATION		
<u>Description</u>	<u>Numerical Value</u>	<u>Effect of Impact</u>
Banks were left intact with less than 5% damage and no major slumpage occurred	1.00	Insignificant
Banks were left intact with from 5% to 10% damage and no major slumpages occurred	0.75	
Banks were greater than 10% to 20% damaged and no major slumpages occurred	0.50	Significant
Banks had received more than 20% damage and/or major slumpages have occurred . .	0.25	

Table 1. (continued)

STREAMSIDE VEGETATION DAMAGE		
<u>Description</u>	<u>Numerical Value</u>	<u>Effect of Impact</u>
Streamside vegetation was damaged not more than 30% after logging	1.00	Insignificant
Streamside vegetation was from 30% to 50% damaged due to logging	0.50	
Over 50% of the streamside vegetation was damaged due to logging	0.25	Significant
OBSTRUCTIONS TO NORMAL FISH MIGRATION		
<u>Description</u>	<u>Numerical Value</u>	<u>Effect of Impact</u>
No obstructions to fish movement	1.00	Insignificant
Obstructions inhibited fish movement	0.50	
Obstructions presented a blockage to fish movement	0.25	Significant

Figure 4: A summary of the relationships between complete adherence and non-adherence to logging recommendations and the resultant effect on the aquatic habitat.



The information summarized in Figure 4 was obtained from the data on Table 2. This Table is shown here to reveal that in some cases, although our recommendations were used, the logging impact was not mitigated. As an example, in the Crane Creek unit there were eleven cases of complete adherence to recommendations for protection of streambanks; however, in one case significant damage resulted. Such unexpected relationships exist in both adherence and non-adherence evaluations. There were 22 (14%) of the 162 cases analyzed (90% of all possibilities) in which the relationship between adherence and non-adherence to specific recommendations and the resultant habitat quality were ambiguous (Table 3). These ambiguous cases were further investigated to determine strengths or weaknesses of our recommendations. The results reveal that 13 of these peculiar cases were attributed to inadequate recommendations, and 6 to inconclusive field observations. The balance were unique situations and were omitted in this evaluation. Notice that 11 of the 13 cases of inadequate recommendations were in the Taholah unit.

Our next analysis was to evaluate and compare the overall effect our recommendations were having for protection of the Reservation's aquatic environment from the total impact of all four logging impacts. A summary of results from the evaluation of the 37 blocks representing 50 streams on the Quinault Reservation is contained in Table 4. Of these streams, 50% were determined to have had a significant logging impact, while only 56% of our recommendations were followed during logging. Clearly, the streams inspected in the Crane Creek management unit received more protection from logging, with only 20% significantly damaged, whereas those streams in the Taholah and Queets units were evaluated as, respectively, 67% and 45% significantly damaged by logging.

Interestingly, 63% of our logging recommendations for the Crane Creek unit were followed while in contrast 52% were followed in both the Queets and Taholah units.

Further detail of the summary data on Table 4 can be found in Table 5. Here the relationship between adherence to specific logging recommendations and the effect on the target logging impact is shown. As an example, in the Taholah unit, 35 recommendations were applicable to the protection of streamside vegetation, and of these 15 (43%) were followed. The results of evaluating the logging impact show that only 29% of the streamside vegetation was protected.

In general, Table 5 demonstrates that in the Crane Creek unit more recommendations were followed (56 - 81%) and the aquatic habitat was least impacted, with from 53 - 80% of the streams protected from the target logging impacts. On the other hand, in the Taholah unit there was less adherence to our recommendations (43 - 46%) and the logging impacts were evaluated as the most damaging, with only 13 - 36% of the streams protected from the target logging impacts. The Queets unit is comparable to Taholah with 40 - 50% of recommendations followed, but the streams fared better with from 36 - 64% protected from the four target logging impacts.

Table 2. The relationship between adherence or non-adherence to specific logging recommendations and related logging damage to the aquatic habitat.

CRANE CREEK UNIT

Impact	<u>Adherence</u>		<u>Non-Adherence</u>	
	<u>Logging Damage</u>		<u>Logging Damage</u>	
	Insignificant	Significant	Insignificant	Significant
Slash	8	0	1	3
Streambanks	10	1	0	2
Streamside				
Vegetation	9	0	0	2
Obstructions	9	0	2	3
Summary	37 Cases	97% Insignificantly Damaged.	13 Cases	77% Significantly Damaged.

QUEETS UNIT

Impact	<u>Adherence</u>		<u>Non-Adherence</u>	
	<u>Logging Damage</u>		<u>Logging Damage</u>	
	Insignificant	Significant	Insignificant	Significant
Slash	5	0	0	4
Streambanks	4	0	1	4
Streamside				
Vegetation	4	0	0	5
Obstructions	6	0	0	4
Summary	19 Cases	100% Insignificantly Damaged.	18 Cases	94% Significantly Damaged.

TAHOLAH UNIT

Impact	<u>Adherence</u>		<u>Non-Adherence</u>	
	<u>Logging Damage</u>		<u>Logging Damage</u>	
	Insignificant	Significant	Insignificant	Significant
Slash	9	1	0	12
Streambanks	5	4	1	10
Streamside				
Vegetation	3	4	3	7
Obstructions	3	4	0	9
Summary	33 Cases	61% Insignificantly Damaged.	42 Cases	90% Significantly Damaged.

Table 3. Cases for which the relationship between complete adherence or non-adherence to logging recommendations and the logging impact was abnormal.

<u>Management Unit</u>	<u>No. of Cases</u>	<u>Status of Adherence</u>	<u>Logging Impact</u>	<u>Remarks</u>
Crane Creek	4	3-Complete 1-Partial	3-Significant 1-Insignificant	2 Cases = field observations inconclusive. 1 Case = inadequate recommendation.
Queets	1	none	insignificant	inadequate recommendation
Taholah	17	13-Complete 4-None	13-Significant 4-Insignificant	11 Cases = inadequate recommendations. 4 Cases = field observations inconclusive.

Summary 13 Cases = inadequate recommendations.
6 Cases = field observations inconclusive.

Table 4. A summary of the results from field observations of adherence to logging recommendations and the logging impact on the aquatic habitat.

Management Area	Adherence to Recommendations	Total Logging Impact to Associated Streams			Total
		Insignificant Damage	Moderate Damage	Significant Damage	
Crane Creek	63% (48/76)	10 (67%)	2 (13%)	3 (20%)	15
Queets	52% (28/54)	5 (46%)	1 (9%)	5 (45%)	11
Taholah	52% (43/83)	5 (20%)	3 (13%)	16 (67%)	24
Summary	56% (118/211)	18 (36%)	7 (14%)	25 (50%)	50

Table 5. Comparison of adherence to specific logging recommendations for stream protection from target logging impact to the number of streams evaluated as having been protected.

Target Impact	<u>CRANE CREEK</u>		<u>QUEETS</u>		<u>TAHOLAH</u>	
	Adherence	Streams Protected	Adherence	Streams Protected	Adherence	Streams Protected
Slash in streams	68% (15/22)	80% (12/15)	50% (11/22)	64% (7/11)	46% (16/35)	36% (9/24)
Streambank degradation	81% (21/26)	73% (11/15)	42% (10/24)	45% (5/11)	45% (14/31)	29% (7/24)
Streamside vegetation	66% (21/32)	73% (11/15)	40% (12/30)	36% (4/11)	43% (15/35)	29% (7/24)
Obstructions	56% (10/18)	53% (8/15)	48% (10/21)	55% (6/11)	46% (11/24)	13% (3/24)

- 1) Protection was assumed when slash was present in less than 20% of the wettable perimeter of streams but no blockages to fish movement were observed.
- 2) Protection to streambanks was assumed when 10% or less were damaged but no major slumpage observed.
- 3) Protection was assumed when not more than 30% of streamside vegetation was damaged.
- 4) Protection from obstructions was assumed when logging associated material represented no more than a hindrance to fish movement.

We were interested to determine why the aquatic habitat of the Queets unit was so different from that of Taholah though recommendations were followed about the same. Two factors which influence the relative degree of success in using recommendations are topography and cedar composition of timber. Of the logging blocks we inspected, these factors vary considerably between the management units as follows:

	<u>Cedar Composition</u>	<u>Steep Terrain</u>
Crane Creek	49%	33%
Queets	67%	55%
Taholah	67%	88%

Notice that in the Taholah unit significantly more steep logging blocks were inspected (88%) than in the Queets (55%) and Crane Creek (33%) units. These figures are believed to be indicative of the general terrain type of each of the management units. The percentage of cedar in the units was supplied from average values from log scaling operations. The information shows that the Queets and Taholah units have comparable but greater amounts of cedar than in Crane Creek.

The data used to develop the above information originated from compilation of the field observations from each of 37 logging blocks representing the Reservation. We have selected three of these for examples and have included them here. However, for further detail, the reader is referred to the Appendix where the field observation, evaluation, maps and pictures of each block are included. The three blocks chosen as examples demonstrate: adherence to logging recommendations and habitat protection; adherence to recommendations but habitat damage; and, finally, minimum adherence to recommendations and habitat damage. We have selected the example of adherence-with-habitat-damage not because, as in the other two samples, it is a common situation, but rather to clearly show that there are a few instances where our recommendations were inadequate.

Case #1: CRANE CREEK UNIT, Block 300. Example of maximum adherence to logging recommendations and habitat protection.

Vital Statistics

Approximate Location: Sec.21, T23N, R11W.
Date of Recommendations: January 3, 1975.
Logging Completed: October 1975.
Date of Post-Logging Inspection: August 28, 1978.
Block Topography: Generally flat.
Timber Composition: Primarily hemlock.
Stream Name: Boulder Creek.

Summary of Results

Adherence to Logging Recommendations. . . .100%.
Aquatic HabitatInsignificantly
Damaged

Stream Description

Boulder Creek, a major tributary of the Quinault River, forms the north-west boundary of the block (see map). This creek averages 8 feet wide with a flow of about 3 cfs on the date inspected. Non-merchantable timber, hardwoods, herbaceous plants, and a dense growth of salmonberry lines the banks (Photos 1 & 2). No point source of silt was evident, but minor, apparently natural, bank erosion was noted. Minimal siltation of streambed gravel was observed (Photo 3). Very little logging-associated slash or debris was observed in the stream. However, slash was present at the high water mark, but was immobilized by the dense streamside vegetation. No logjams, bridges, or culverts were present on this stream.

Recommendations and Adherence

General recommendations were suggested for this block, but only the applicable recommendations are listed below. Adherence to these recommendations is indicated as follows: A=complete adherence; P=partial adherence; ND=adherence was not discernible; NA=non-adherence.

AdherenceRecommendation

A	Timber shall be felled away from the stream.
ND	Leaners may be felled perpendicular to and across stream, provided they are yarded out after being felled.
A	All logs shall be yarded away from streams.
A	Streambank vegetation shall be protected, and non-merchantable timber shall be left standing along streams.
A	All debris which accidentally falls into streams shall be removed.
A	Any logjams in the timber blocks shall be removed during yarding operations.
A	Windfalls shall be removed unless one end is buried in the bank or streambed.
A	Logging roads shall follow the contour of the land, be built to prevent turbid water from draining into the stream, and be kept back from the streambanks.

Numerical Evaluation of Logging Impacts

<u>Impact</u>	<u>Rating</u>	<u>Extent of Habitat Damage</u>
Slash	1	Insignificant
Bank Damage	1	Insignificant
Streamside Vegetation	1	Insignificant
Obstructions	1	Insignificant
- - - - -	-	-
Overall Rating	4	Insignificantly Damaged

Comments

Our recommendations were closely adhered to, and the aquatic habitat was evaluated to have been protected from adverse logging impacts. The flat topography and timber species in this block were probably beneficial factors contributing to the desirable results observed. The most important factor contributing to the protection of the aquatic habitat in this block, however, is the preservation of the partial buffer strip during logging (Photo 1). This prevented destruction of banks, streamside vegetation and blocked logging debris from entering the stream.

Crane Creek Unit, Block 300
Sec. 36, T23N, R11W.
Date Inspected: 8/28/78



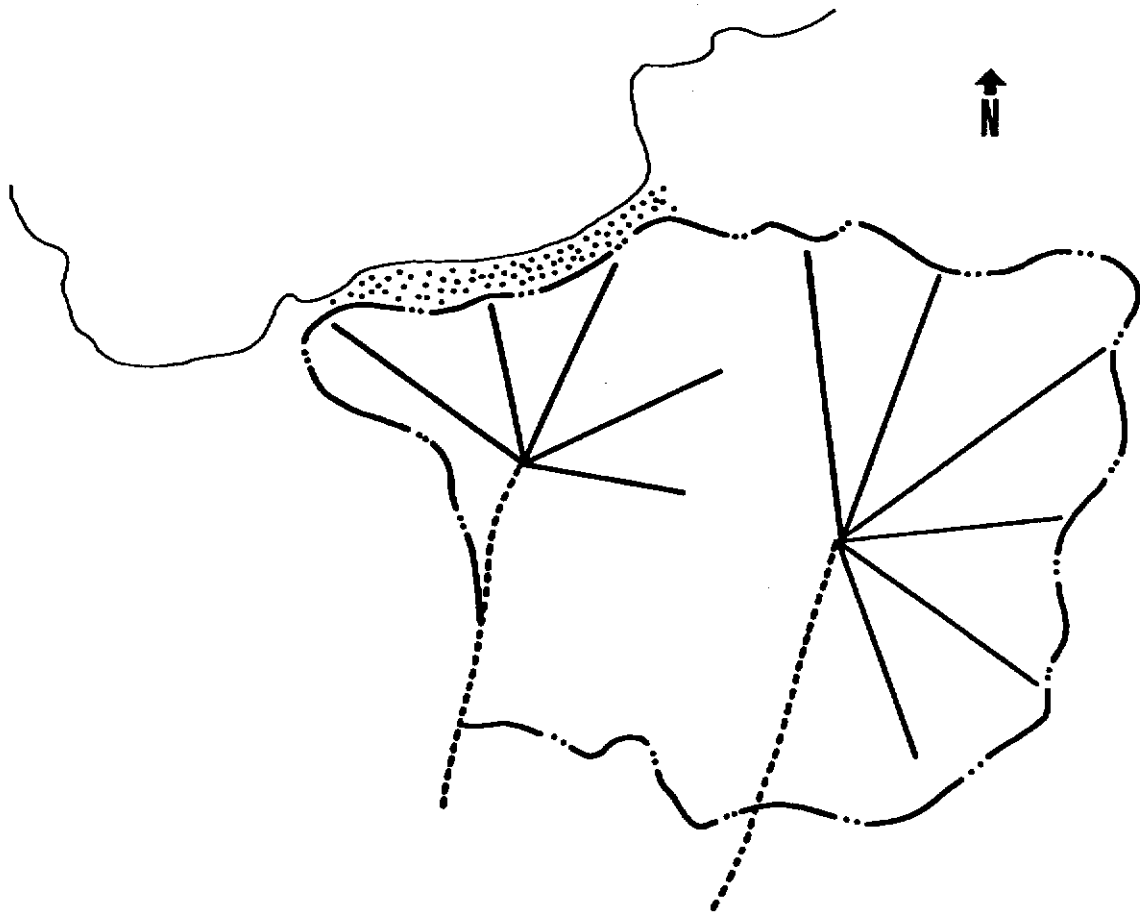
Photo 1. Buffer strip of non-merchantable timber remaining on bank of Boulder Creek.



Photo 2. Dense salmonberry along Boulder Creek (arrow points to stream location).



Photo 3. Vegetation, clean gravel (circle), Boulder Creek.



Reproduction of aerial photograph of block 300 . Included are logging block boundaries, roads, yarding patterns, and streams. Note buffer strip (dots).

Boundaries —····—

Roads - - - - -

Yarding Patterns ←

Streams ~~~~~

Case #2: TAHOLAH UNIT, Block 154. Example of maximum adherence to logging recommendations but significant logging-associated habitat damage.

Vital Statistics

Approximate Location: Sec.10, T22N, R12W.

Date of Recommendations: January 26, 1973.

Logging Completed: November 1975.

Date of Post-Logging Inspection: August 15, 1978.

Block Topography: Flat, with some rolling hills.

Stream Name: No name; north and south headers to the South Fork of the Raft River.

Summary of Results

	<u>North Trib.</u>	<u>South Trib.</u>
Adherence to Logging Recommendations. . .	100%	100%
Aquatic Habitat	Significantly Damaged	Significantly Damaged

Stream Description

Two tributaries to the Raft River drain this block (see map). The stream-banks were essentially void of vegetation having only a scant amount of moss and herbaceous plants (Photos 1-3). Although the water in the stream appeared clean, streambed gravel was heavily silted. Perhaps obvious logging-associated bank slumpage may have contributed to the accumulated silt (Photo 2). Moderate to heavy slash accumulation was noted in the streams and along the banks; however, post-logging stream cleaning was complied with. Several slash webs represent blockage to fish movement (Photo 1).

Recommendations and Adherence

Adherence to recommendations apacific to this block is indicated as follows: A = complete adherence; P = partial adherence; ND = adherence was not discernible; NA = non-adherence.

<u>Adherence</u>	<u>Recommendation</u>
(Both Tributaries)	
ND	There should be no problems in felling trees uphill and away from the streams.
A	There should be no problems in yarding trees uphill and away from the streams.
A	Any debris that inadvertently falls into the stream should be removed so that a highly visible stream is present when logging operations are completed.

Numerical Evaluation of Logging Impacts

<u>Impact</u>	<u>North Tributary</u>		<u>South Tributary</u>	
	<u>Rating</u>	<u>Extent of Habitat Damage</u>	<u>Rating</u>	<u>Extent of Habitat Damage</u>
Slash	.50	Significant	.75	Insignificant
Bank Damage	.25	Significant	.25	Significant
Streamside Vegetation	.25	Significant	.25	Significant
Obstructions	.50	Significant	.50	Significant
Overall Rating	1.50	Significantly Damaged	1.75	Significantly Damaged

Comments

Our recommendations did not provide adequate aquatic habitat protection. Slash removal was not specific enough. Although stream clearing was completed, slash was not thrown sufficiently away from the stream to prevent reentry during high runoff or flooding. In this case, slash was one of the major causes of streamside vegetation damage, as well as presenting obstructions to fish movement. The slash problem may have been avoided if our recommendation had specified removal to at least 100 feet from the stream, or out of the 50-year highwater mark. In addition, streambank damage would have been minimized if recommendations had specified leaving stabilized windfall within banks.

Taholah Unit, Block 154
Sec. 10, T22N, R11W.
Date Inspected: 8/15/78



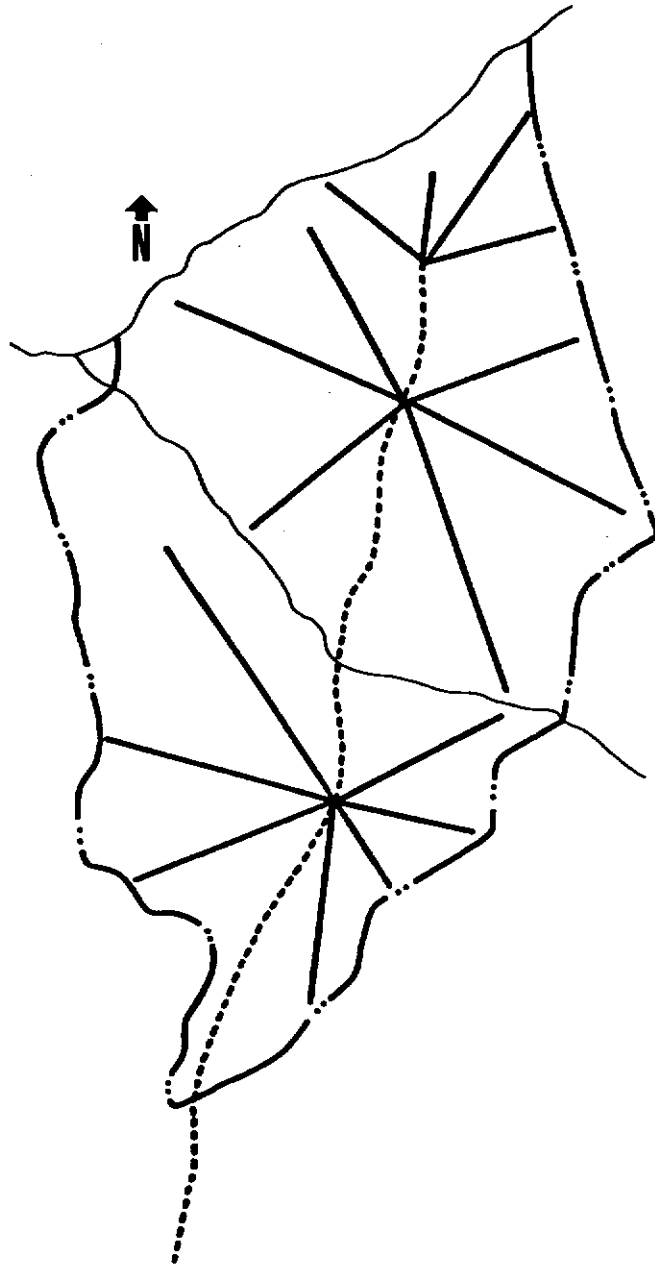
Photo 1. Tributary to South Fork Raft River: section of stream that had been cleaned. Note slash that has washed back into the stream (circle).



Photo 2. Tributary to South Fork Raft River: section of stream with bank damage from removal of a stabilized windfall (circle).



Photo 3. Tributary to South Fork Raft River: looking downstream on area that had been cleaned. Note heavy slashloads on streambanks, covering streamside vegetation. (circle).



Reproduction of aerial photograph of block 154 . Included are logging block boundaries, roads, yarding patterns, and streams.

Boundaries ————

Yarding Patterns 

Roads - - - - -

Streams 

Case #3: QUEETS UNIT, Allotment 1126. Example of minimum adherence to logging recommendations and significant aquatic habitat damage.

Vital Statistics

Approximate Location: Sec.15, T23N, R12W.

Date of Recommendations: September 22, 1976.

Logging Completed: May 1978.

Date of Post-Logging Inspection: September 7, 1978.

Block Topography: Flat-to-rolling hills on the banks of the Raft River; steep drop down to the tributary.

Stream Name: North Fork of the Raft River and tributary.

Summary of Results

	<u>North Fork</u>	<u>Tributary</u>
Adherence to Logging Recommendations. . .	83%	33%
Aquatic Habitat	Insignificantly Damaged	Significantly Damaged

Stream Description

The North Fork Raft River and a small feeder stream flow through this block. The tributary was covered with slash and vegetation was sparse (Photos 1 & 2). Although on the North Fork there were a few instances of significant damage to streamside vegetation, it was generally well-established (Photos 3 & 4). Minimal bank erosion was noted, but stream-bed gravel was moderately silted. Large amounts of debris were present at the stream high-water mark, but little was seen in the stream (Photo 4).

Recommendations and Adherence

Adherence to general and specific recommendations for this block is indicated as follows: A = complete adherence; P = partial adherence; ND = adherence was not discernible; NA = non-adherence.

<u>Adherence</u>		<u>Recommendation</u>
<u>North Fork</u>	<u>Tributary</u>	
A	NA	All timber shall be felled away from streams.
ND	ND	Leaners may be felled perpendicular to and across streams, provided they are yarded out tree-length after being felled.
A	NA	All logs shall be yarded away from streams. Several settings should be made, if necessary, to avoid yarding across streams except when slack-line, balloon, or helicopter yarding is used.
NA	NA	Streambank vegetation shall be protected and non-merchantable timber shall be left standing along streams.
A	NA	All debris which accidentally falls into streams shall be removed.
A	ND	Any logjams in the timber blocks shall be removed during yarding operations. Windfalls shall be removed unless one end is buried in the bank or streambed.
--	A	No cat logging shall be allowed on slopes of greater than 30° during the wet season.
A	A	Logging roads shall follow the contour of the land, be built to prevent turbid water from draining into the stream, and be kept back from streambanks.

Numerical Evaluation of Logging Impacts

<u>Impact</u>	<u>North Fork</u>		<u>Tributary</u>	
	<u>Rating</u>	<u>Extent of Habitat Damage</u>	<u>Rating</u>	<u>Extent of Habitat Damage</u>
Slash	.75	Insignificant	.25	Significant
Bank Damage	.75	Insignificant	.25	Significant
Streamside Vegetation	1.00	Insignificant	.25	Significant
Obstructions	1.00	Insignificant	.25	Significant
Overall Rating	3.50	Insignificantly Damaged	1.00	Significantly Damaged

Comments

Recommendations made for the tributary stream were poorly used during logging. Consequently the associated aquatic habitat was significantly damaged due to logging impacts. However, when recommendations were used for protection of the North Fork of the Raft River, the aquatic habitat was protected from logging impacts. There was, perhaps, some aggravation of logging impact to the tributary due to the steep terrain, but the majority of habitat damage resulted from logging without regard to the habitat protection measures recommended.

Queets Unit, Allotment 1126
Sec. 15, T23N, R12W.
Date Inspected: 9/7/78



Photo 1. Tributary to North Fork of the Raft River from spur road. Slash completely obscured stream (arrows indicate location of channel.)



Photo 2. Tributary to North Fork of the Raft River (from spur road) showing slash and debris in the stream (circle and arrows indicate location of channel).

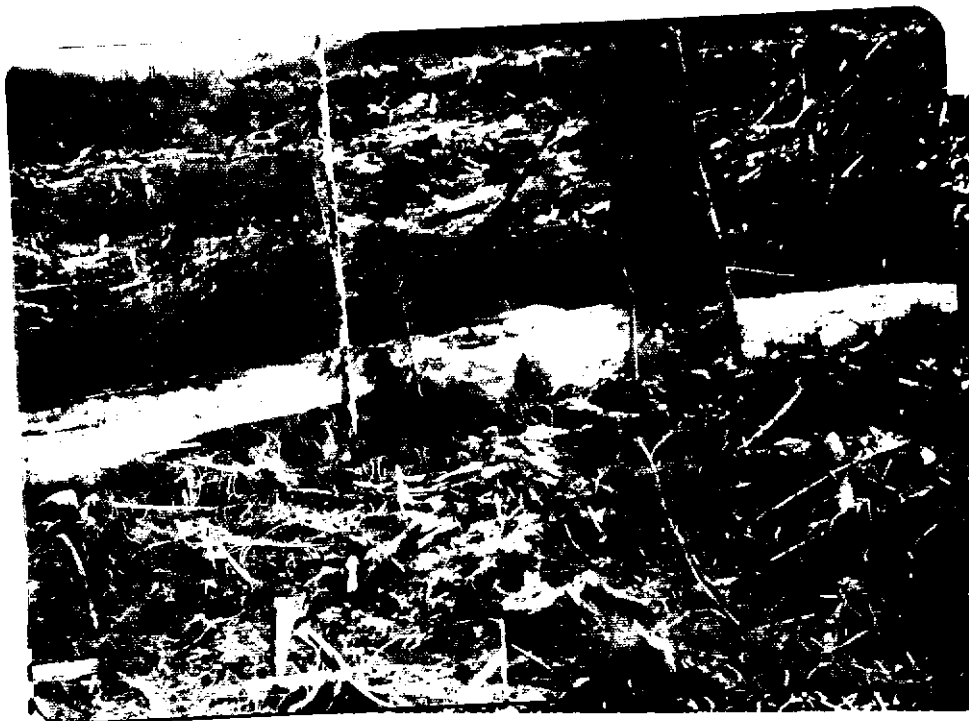
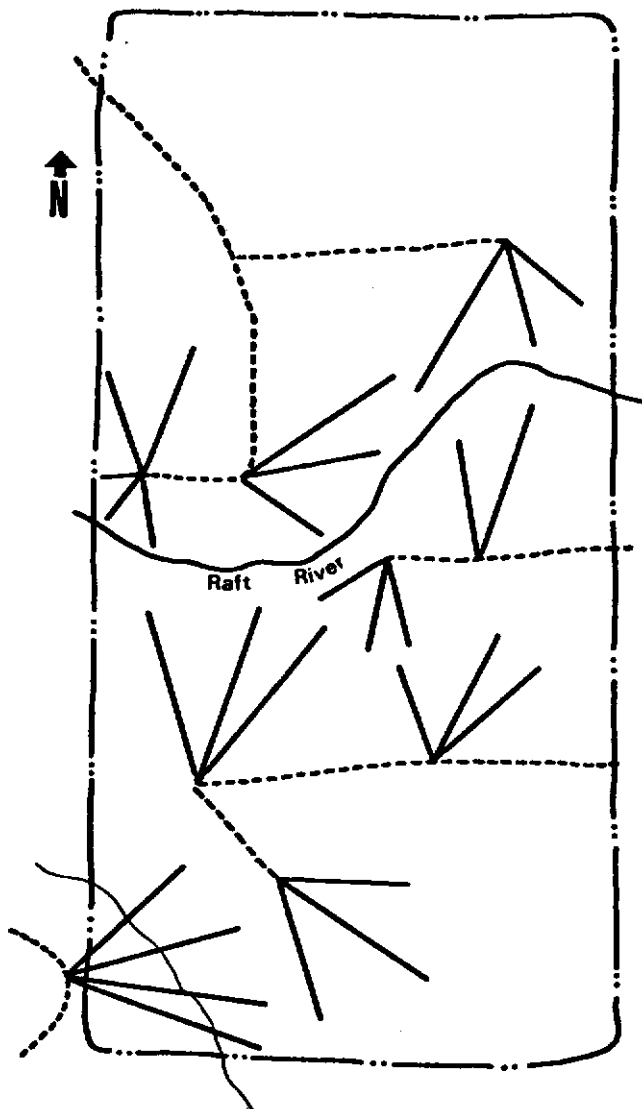


Photo 3. North Fork of the Raft River: note remaining non-merchantable trees, (arrows).



Photo 4. North Fork of the Raft River, showing steep banks in background (arrow) and slash at high water mark, (Circle).



Reproduction of aerial photograph of allotment 1126 . Included are logging block boundaries, roads, yarding patterns, and streams.

Boundaries ————

Yarding Patterns

Roads - - - - -

Streams

DISCUSSION

Achieving a balance to resource management on the Quinault Indian Reservation should be a goal to which managers give serious consideration. Still, the data presented here again demonstrates a now almost historic imbalanced management effort. The forest resource has received the overwhelming consideration; and although in recent times some major strides for aquatic habitat management have been achieved, the damage to this valuable resource is still significant. Factors which have contributed to the aquatic habitat degradation, by order of importance, are:

1. poor use of logging recommendations;
2. topography;
3. timber type; and
4. inadequate recommendations.

The use of logging procedures which were recommended for aquatic habitat protection have been shown to provide that protection. As a matter of fact, however, only about 56% of such recommendations are used on the Reservation. Not only are such habitat protection measures insufficiently incorporated into normal operations, but the percentage of recommendations used is artificially inflated through the methods we used for evaluation. A case in point was adherence to our recommendation to "not cat log". Such a logging method is no longer generally used as in the past, and this recommendation has been used inappropriately on logging blocks where cat logging was not considered as a viable harvest method. Comparable to this is adherence to recommendations regarding roads. We commonly recommend that roads follow the contour of the land and be set back from streams. From a logging point of view, this is advantageous and normal procedure wherever possible since road costs are less and timber yarding is more efficient. Although the result is habitat protection, the recommendation is generally unnecessary.

Since both of these recommendations were used in the evaluation of adherence to our recommendations, the resultant figure is somewhat high. However, it should be pointed out that cat logging was commonly used when we began developing recommendations and roads can cause major damage to the aquatic habitat. Perhaps, as in the case of cat logging, our recommendations will become increasingly less unique to usual logging procedures and redundant of normal operations.

It has been brought out in this report that both recommendation use and aquatic habitat were better in the Crane Creek unit than in either the Queets or Taholah units. However, the percentage of adherence to recommendations was not felt to be different enough to account for the extreme difference in damage to the aquatic habitat. We attribute this habitat damage only partly to the difference in adherence to recommendations and feel that both topography and timber type have major influence on the degree of logging damage to the aquatic environment.

Perhaps the most influential of these factors is topography. Differences in topography between the three management units were apparent during field observations and we found that only 33% of the blocks inspected in Crane Creek were steep terrain; the aquatic habitat was least damaged by logging. In contrast, 88% of the blocks inspected on Taholah were of canyon-like character and the aquatic habitat was most damaged by logging. In the Queets unit, about 55% of the blocks inspected were steep and the logging impact was between the above. We feel that this difference in topography had a significant effect on the degree of impact resulting from logging and is necessarily a factor in the relative aquatic habitat damage between the three units. The steepness of the terrain influences logging impact by essentially providing a slide which aggravates slope damage from rolling or sliding timber. Such timber movement can also severely damage sensitive side slopes by destroying stabilizing vegetation and mechanically eroding banks. In addition, timber felling on such steep slopes can result in a majority of timber directly entering streams flowing through the bottom of canyons. This concentration of timber results in massive quantities of debris and slash remaining within streams after yarding. This material, even if removed from streams, as is often recommended during post-logging cleanup, is highly mobile and will reenter streams as a result of surface runoff during heavy rain and/or flooding conditions. To remove such threat, it would be necessary to either not log or completely remove or immobilize logging debris from the sides of canyons.

The other factor, acting concurrently with topography to influence the quality of aquatic habitat in the three units, is timber type. Cedar, particularly old-growth cedar, is a major source of logging slash. This material accumulates due to the abundance of limbs and the fragile nature of old trees. In addition, cedar slash persists for up to 100 years whereas such material from hemlock will decompose in about 10 years.

The proportion of cedar varies between the three management units, with Crane Creek averaging 49% and the Taholah and Queets units about 67%. In addition to the greater amounts of cedar in Taholah, there were more blocks with steep terrain than in the other units. These factors probably added appreciably to the significance of the logging damage in Taholah compared to Crane Creek. Additional validity to the overriding influence of topography is demonstrated when contrasting Taholah to the Queets unit. Although adherence to our logging recommendations were identical and the cedar composition about the same, the damage to the aquatic habitat in Taholah was found to be about twice that in Queets. The reason for this difference we attribute to topography. The Taholah unit sample was 88% steep terrain whereas Queets was 55% steep terrain. With the relationship between topography and cedar slash in mind, the differences between our evaluation of specific logging damage is more readily appreciated. For example, obstructions were found to be a very significant problem in the Taholah unit, less in Queets and least in Crane Creek. This trend directly reflects the steep topography and cedar quantity present in the units. However, it must be emphasized

that the adherence to logging recommendations also has a strong influence on logging impact. In this regard we have clearly shown that the Taholah and Queets units had less adherence to recommendations than did Crane Creek.

The final factor contributing to aquatic habitat damage was inadequacy of recommendations. This is particularly the situation in the Taholah unit and is probably again a reflection of both the steep terrain and cedar composition. In the Taholah unit we have made recommendations that were inadequate due to insufficient directions, or inappropriate because of advising protective logging measures on streams of questionable value.

The data presented here is believed to be a good indication of the status of aquatic habitat management on the Quinault Reservation. However, two factors must be discussed which demonstrate that this report is perhaps best used as a tool for achieving more reliable data for improvement of conditions on the Reservation. One of these factors is the manner in which our data was gathered. Our evaluation of aquatic habitat protection was made, almost without exception, with no knowledge of the habitat conditions prior to logging, or, in most instances, immediately after logging. This lack of comparative conditions weakens the data presented in the report and is particularly important when natural post-logging changes have taken place. Generally, when several years have lapsed since logging, the natural changes become important; the capacity of streamside vegetation to re-bound after logging is a good example. Vegetative growth will mask the logging impact, if any, and influence the numerically-determined degree of habitat protection. Although the methods used in this evaluation were the only plausible alternatives, this example demonstrates that greater precision can be obtained only by direct and timely comparison of pre- and post-logging habitat conditions.

The second factor is that the methods to evaluate habitat damage create a more optimistic impression of the habitat quality than probably exists. The reason for this is simply that a single logging impact such as an obstruction to fish migration essential removes all upstream value for potential fish use. Although this single impact has far-reaching detrimental effects, it can be masked by upgrading through evaluation of the remaining target logging impacts. This is exactly the situation realized in logging block #226 of the Crane Creek unit (see Appendix).

CONCLUSION

Aquatic habitat protection implies aquatic habitat value. Value can include not only economics, as in the case of timber and fish, but also, and of equal importance, the more intangible aesthetic, recreational, cultural and/or historic values. It is important to emphasize that this

evaluation of the protection of the aquatic environment from detrimental effects of logging has not addressed aquatic habitat value. This is because no value system has been established for the aquatic resources of the Reservation. This has been left to the judgment of those developing recommendations for logging. Clearly, balanced resources management must be a compromise and relative value must be used for management of the aquatic resources. From our review of the logging blocks inspected for this study it is apparent that in some situations the recommendations may have been inappropriate, at least when considering the fish-value of the aquatic habitat. This situation seems particularly prevalent in the Taholah unit, where stream gradients are often so severe as to make fish habitat essentially non-existent. However, value of such streams may still be high based on other factors. These other values need identification and it is essential that further advancement toward increased aquatic habitat protection be based upon a complete stream classification system.

Considerable change has occurred in resource management on the Quinault Indian Reservation since our involvement began in 1972. Better aquatic habitat management is indeed occurring. Today the once-extraordinary logging practices aimed at habitat protection are becoming "business as usual" logging norms. Such practices include: cable felling and use of hydraulic jacks to mechanically force trees from entering streams; stream cleaning after logging; and summer logging to protect spawning fish populations and lessen erosion.

Although the situation is encouraging, the data presented here indicates that more effort is necessary to obtain a balance between timber and aquatic resources. One obvious step to achieve a balance is greater adherence to recommendations developed with respect to aquatic habitat value. Another step is to develop more precise recommendations. This is particularly necessary on the Taholah and Queets units, where topography must be constantly considered.

Based on the trends and relationships investigated in this study, we have the following suggestions:

1. Forest practices guidelines must be mutually developed for standard logging procedures aimed at aquatic habitat management. Such a document exists and we strongly endorse complete adoption of the "Forest Practice Regulations" prepared by the Quinault Indian Nation in cooperation with the BIA, USFWS, and Washington Department of Natural Resources (WDNR).
2. Logging activities should be planned to insure wide distribution in both space and time of impacts to the aquatic resource
3. The pre-logging recommendation methodology must include greater site detail. Information should include approximate quantity of streamside vegetation, description of streambanks, and character-

istics of streams, such as water clarity and flow, gravel condition, stream dimensions, and potential fish use.

4. More emphasis must be placed on the implementation of specific aquatic habitat protection measures during preparation of and actual timber harvest.
5. The effectiveness of aquatic habitat protection must be determined as soon as possible after completion of logging.
6. Recommendations for aquatic habitat protection must be used more effectively during logging operations.

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